Fusarium species from Marion and Prince Edward Islands: sub-Antarctic

J.P. Rheeder*, P.S. van Wyk[1] and W.F.O. Marasas

Research Institute for Nutritional Diseases, South African Medical Research Council, P.O. Box 70, Tygerberg, 7505 Republic of South Africa and [1]Department of Plant Pathology, University of the Orange Free State, Bloemfontein, 9300 Republic of South Africa

[1]Present address: Department of Microbiology, University of the Orange Free State, P.O. Box 339, Bloemfontein, 9300 Republic of South Africa

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Fusarium species were isolated from plant debris in 27 soil samples representing the major habitat and vegetation types of Marion and Prince Edward Islands. The survey provided qualitative and quantitative information on the occurrence, distribution and ecology of *Fusarium* spp. in these subantarctic soils and is to our knowledge the first report of *Fusarium* spp. from the subantarctic. Altogether 432 *Fusarium* isolates were recovered after plating plant debris on a selective medium. The most prevalent *Fusarium* sp., which comprised 73% of the isolates obtained from Marion Island and 82% of the isolates from Prince Edward Island, was *F. merismoides* Corda. Two other species (*F. acuminatum* Ell. & Ev. and *F. reticulatum* Mont.) occurred at similar frequencies to each other and were more prevalent in areas that were influenced by animal and bird activity. A number of *F. reticulatum* isolates were obtained from isolations made from necrotic leaf tissue of *Pringlea antiscorbutica* R. Br.

Fusarium-spesies is geïsoleer uit plantreste in 27 grondmonsters verteenwoordigend van die hoofhabitat en plantegroeitipes van Marion- en Prince Edwardeilande. Die opname het kwalitatiewe en kwantitatiewe gegewens oor die voorkoms, verspreiding en ekologie van *Fusarium* spp. in hierdie subantarktiese gronde verskaf, en is na ons wete die eerste melding van *Fusarium* spp. in die subantarktika. Altesame 432 *Fusarium*-isolate is verkry na uitplating van plantreste op 'n selektiewe medium. Die mees algemene *Fusarium*-sp. wat 73% van die isolate vanaf Marioneiland en 82% van die isolate vanaf Prince Edwardeiland uitgemaak het, was *F. merismoides* Corda. Twee ander spesies (*F. acuminatum* Ell. & Ev. en *F. reticulatum* Mont.) het soortgelyke frekwensies in vergelyking met mekaar gehad en het 'n hoër voorkoms in areas wat deur dier- en voël-aktiwiteite beïnvloed was, gehad. 'n Aantal *F. reticulatum*-isolate is verkry vanaf isolasies wat uit nekrotiese blaarweefsel van *Pringlea antiscorbutica* R. Br. gemaak is.

Keywords: *Fusarium*, plant debris, soil, subantarctic islands, vegetation

*To whom correspondence should be addressed

Introduction

Marion Island (46° 54′S, 37° 45′E) and its smaller neighbour Prince Edward Island (46° 38′S, 37° 57′E), 22 km to the north-east, are situated in the subantarctic region 2 300 km south-east of Cape Town.

Marion Island (and similarly Prince Edward Island) experiences low temperatures (annual mean 5.1°C), high rainfall (>2 500 mm per annum) and a high incidence of galeforce winds (Schulze 1971). Both islands consist of two distinct lava types, a grey preglacial and a black postglacial eruption. The influence of geology on vegetation is through variation in microclimate and soil drainage, rather than through chemical differences in the lava types (Huntley 1971). A comprehensive review of the the chemical composition of the soils and the plant ecology of Marion Island is given by Smith (1977, 1978). Manuring by birds and seals markedly enhances soil microbial populations by adding nutrients and possibly energy sources to the soils (Steyn & Smith 1981; Grobler *et al.* 1987).

Fusarium spp. have been recorded in the subarctic region from tundra and glaciated soils in Alaska (Stoner 1981), and from soils and plant roots in Iceland (Kommedahl *et al.* 1975). In the subantarctic, however, only brief reference is made to fungi in general on Marion and Prince Edward Islands (Joubert 1971; Steyn & Smith 1981). Mercantini *et al.* (1989) studied the distribution of keratinophilic and other fungi on the Antarctic Continent, but found no *Fusarium* spp. According to Corte & Daglio (1963), Tubaki is the only person to refer to a *Fusarium* sp. isolated from the Antarctic. To our knowledge, *Fusarium* spp. have not previously been recorded in the subantarctic region.

This paper reports on the first intensive survey of *Fusarium* spp. on these subantarctic islands. The frequency of *Fusarium* spp. was determined in plant debris associated with various biotically and non-biotically influenced soil environments. Isolations were also made from necrotic leaves of *Pringlea antiscorbutica* R. Br.

Materials and Methods

Soil sampling sites and procedures

During April–May of 1985 and 1986 soil samples (± 500 g/sample) were collected from Marion (Figure 1) and Prince Edward (Figure 2) Islands. A description of each sampling site is summarized in Table 1. Each location indicated represents four separate subsamples (several

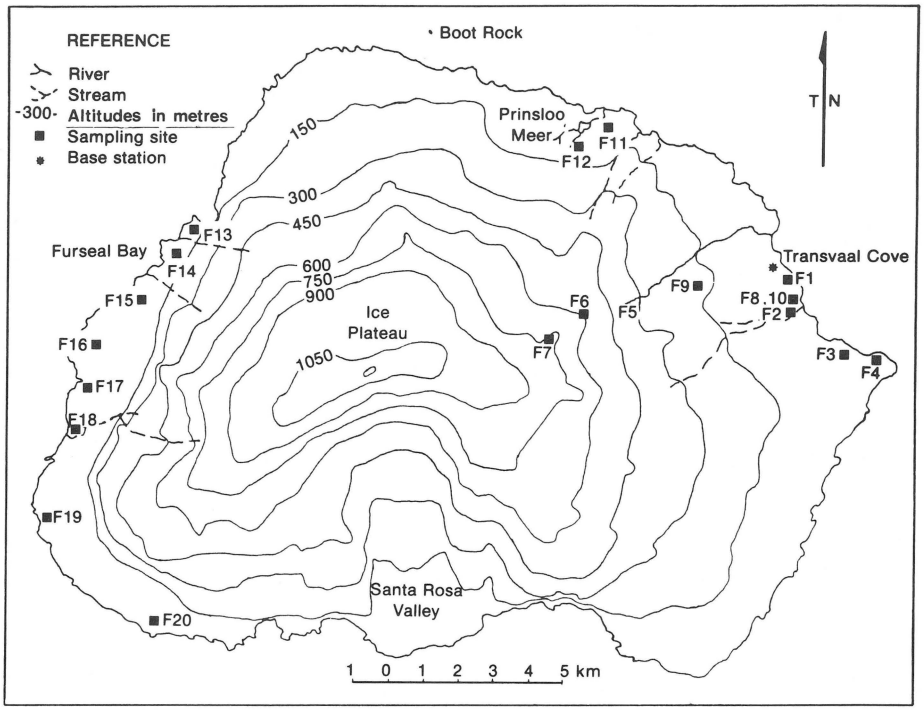

Figure 1 Location of soil sampling sites on Marion Island.

metres apart, depending on the terrain and vegetation) taken from the top 10 cm of soil and then bulked. Plant residues and rocks were removed from the soil surface before the subsamples were collected with a hand trowel. The samples were placed in polyethelene bags and taken to the station on Marion Island.

Extraction of plant debris from soil

Soil samples were treated as described by Nelson *et al.* (1983) for the extraction of plant debris. The resultant debris samples were allowed to dry in a heated (18–25°C) room, sealed in polyethelene bags and returned to the laboratories of the University of the Orange Free State for analysis.

Isolation and identification of *Fusarium* species

The collected debris was plated on a selective *Fusarium* isolation medium (SFA) (van Wyk *et al.* 1986). One

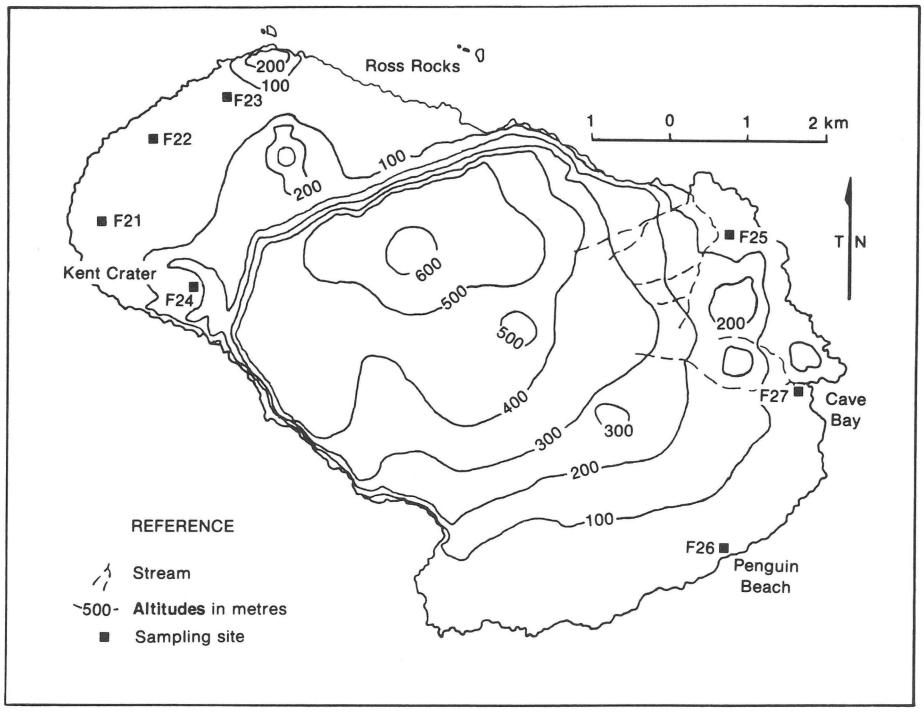

Figure 2 Location of soil sampling sites on Prince Edward Island.

hundred pieces of debris from each soil sample were plated out (10 debris pieces/petri dish) and incubated at 10°C for 7 days and then at 25°C for another 7 days. The fungal colonies that developed were transferred to plates of potato-dextrose agar to which 30 mg dm^{-3} streptomycin had been added (PDAS). Cultures of *Fusarium* spp. isolated on PDAS were single-spored, transferred to potato-dextrose agar (PDA) and carnation leaf agar (CLA) (Fisher *et al.* 1982) and identified according to Nelson *et al.* (1983). Representative isolates were deposited in the culture collection of the Medical Research Council (MRC), Tygerberg.

Isolation from *Pringlea* leaves

Leaves of the indigenous plant *Pringlea antiscorbutica* (Brassicaceae), which had dark necrotic lesions, were collected near the meteorological station. These leaves were dried in a heated (18–25°C) room, sealed in a polyethelene bag and returned to South Africa. Small sections of the necrotic leaves were plated on SFA (25 leaf pieces) and also on water agar (25 leaf pieces) to which 30 mg dm^{-3} streptomycin had been added. These plates were incubated at 10°C for 7 days and then at 25°C for another 7 days. The colonies that developed were treated similarly to those from the debris plates.

Results

Fusarium species isolated from plant debris

The frequency of isolation of each *Fusarium* sp. from each plant debris sample is given in Table 2. Only three species of *Fusarium* were isolated from the islands' soils and are listed with their respective sections as in Nelson *et al.* (1983): *F. merismoides* Corda in the section Eupionnotes, *F. acuminatum* Ell. & Ev. in the section Gibbosum, and *F. reticulatum* Mont. in the section Discolor. A total of 432 *Fusarium* isolates were recovered from the 27 plant debris samples.

The most frequently isolated species from soils from both islands was *F. merismoides*, comprising 73% of the total isolates from Marion Island and 82% from Prince Edward Island. The species totals for *F. acuminatum* and *F. reticulatum* are relatively low for both islands and both were isolated with similar frequencies, *F. acuminatum* being slightly more prevalent than F. reticulatum.

Isolations from necrotic *Pringlea* leaves

The only fungus isolated from the *Pringlea* leaf pieces was *F. reticulatum*. This species was isolated from 12 of the 50 plated necrotic leaf pieces.

Discussion

All three *Fusarium* species isolated from plant debris during the present survey are soil-inhabiting fungi that exist either as saprophytes and/or as non-aggressive plant pathogens. *F. merismoides* [syn. *F. episphaeria* (Tode) Snyd. & Hans. pro parte] (Nelson *et al.* 1983) is common in soil and in polluted water or sludge (Booth 1971), but was not recorded during a recent survey of South African soils (Marasas *et al.* 1988). It was found to be common in Icelandic soils (Kommedahl *et al.* 1975).

Table 1 Description of the habitats and environments on Marion and Prince Edward Islands from which soil samples were taken

Soil sample	Description of habitat and environment
Marion Island	
F1	Salt-spray area frequented by gulls and penguins
F2	Coastal mire with previous biotic activity
F3	*Blechnum*-slope. No animal activity
F4	Tussock grass slope. Burrowing bird habitat
F5	Inland mire. No animal activity. Altitude ± 320 m
F6	Fjaeldmark slope. No animal activity. Altitude ± 600 m
F7	Bare, unvegetated lava. Only moss present. Altitude ± 750 m
F8	Grass slope. An albatross nesting area
F9	Scoriae (reddish-brown volcano rock) fjaeldmark. No animal activity
F10	Seal wallow area
F11–20	Coastal mire sites heavily influenced by salt spray and animal activity
Prince Edward Island	
F21	Grass slope on black lava substrata
F22	Fjaeldmark plain. No animal activity
F23	Good vegetation, grass predominating
F24	Well-vegetated area within old crater. Very rocky lava sand
F25	Grass-vegetated valley, frequented by numerous albatross
F26	Taken near a penguin breeding area
F27	Good vegetation next to river. Penguin site nearby

F. acuminatum [syn. *F. roseum* (Lk.) emend. Snyd. & Hans. 'Acuminatum'] (Nelson *et al.* 1983) occurs worldwide as a soil saprophyte, is closely associated with a variety of plants (Booth 1971) and is known to have a specific plant association with legumes (McMullen & Stack 1984). This species was most frequently isolated from grass roots in Iceland, but not as frequently from the soil (Kommedahl *et al.* 1975). *F. reticulatum* [syn. *F. roseum* (Lk.) emend. Snyd. & Hans. pro parte] (Nelson *et al.* 1983) could also have been present amongst the fungi isolated by Kommedahl *et al.* (1975) from Icelandic soils and plant roots. *F. acuminatum* and *F. reticulatum* were both recorded from South African soils by Marasas *et al.* (1988).

F. merismoides is the only one of the three fungi found at fjaeldmark areas (F6, F22), which are characterized by bare expanses of rock and scoriae and dominated by the cushion plant *Azorella selago* Hook. f. Fjaeldmark is the primary habitat on the island from which all other plant communities are derived through ecological succession (Smith 1987). Our results suggest, therefore, that *F. merismoides* could be the initial colonizing *Fusarium* sp. of plant debris. *F. acuminatum* and *F. reticulatum* appear to follow as the area becomes more vegetated with various other plant species and is frequented by seals, penguins or other birds. This would agree with the suggestion made by Stoner (1981) that *Fusarium* spp. can be used as important indicators of the

Table 2 Frequency and identity of *Fusarium* species isolated from plant debris found in soil on Marion and Prince Edward Islands

	Number of *Fusarium* isolates[a]																			
	Marion Island sampling sites																			Species
Fusarium species	F1	F2	F3	F4	F5	F6	F7	F8	F9	F10	F11	F12	F13	F14	F15	F16	F17	F18	F19	F20	total
F. merismoides	6	4	5	44	2	5	0	15	0	70	4	2	2	0	53	0	2	5	2	0	221
F. acuminatum	2	1	1	25	0	0	0	11	0	2	1	1	0	0	0	0	0	1	1	0	46
F. reticulatum	4	0	0	25	0	0	0	2	0	2	0	1	0	0	0	0	2	1	0	0	37
Site total	12	5	6	94	2	5	0	28	0	74	5	4	2	0	53	0	4	7	3	0	304

	Prince Edward Island sampling sites							
								Species
Fusarium species	F21	F22	F23	F24	F25	F26	F27	total
F. merismoides	0	17	7	52	3	15	11	105
F. acuminatum	0	0	1	2	0	9	1	13
F. reticulatum	0	0	0	3	1	5	1	10
Site total	0	17	8	57	4	29	13	128

[a]Number of isolates obtained from 100 debris pieces from each site

stages of ecological succession and community development.

It appears that the presence of animal and bird activity enhances the prevalence of the abovementioned three *Fusarium* species, which supports the findings of Steyn & Smith (1981) with respect to microbial populations in Marion Island soils. The prevalence of *F. acuminatum* and *F. reticulatum* was highest at a burrowing bird habitat (F4), while *F. merismoides* was also isolated at high frequencies at this location. On a grass slope frequented by nesting albatross (F8), the incidence of *F. merismoides* and *F. acuminatum* was relatively high. The incidence of *F. merismoides* was at its highest at a seal wallow area (F10). Two well-vegetated locations in close proximity to animal or bird activity (F24, F26) also had high *Fusarium* populations. Conversely, those environments that were not biotically influenced and were sparsely vegetated (fjaeldmark) had some of the lowest *Fusarium* frequencies recorded. This is supported by the low *Fusarium* counts from a *Blechnum*-slope (F3) and an inland mire (F5), both with no animal activity. The *Fusarium* population at F5 could also, however, have been influenced by the waterlogged soil conditions.

The possibility exists that *F. reticulatum* caused the necrotic lesions on the *Pringlea* leaves, but this has not been proven by pathogenicity tests.

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